[001] GEAR SHIFT DEVICE

[002]

[003]

[004] The present invention relates to a gear shifting system for idler wheels in accordance with the preamble of patent claim 1.

[005]

[006] Gear shifting systems, where shifting occurs by means of axial displacement of sliding sleeves, are known from the state of the art. This way, the sliding sleeve concerned can connect an idler wheel to be shifted form-locking with a main shaft. Displacement of the sliding sleeve is accomplished in the familiar gear shifting systems through shifting elements, such as drivers, shift rails and shift forks. In order to accommodate these necessary components in the transmission, additional operations are required on the gearbox housing, which are disadvantageous.

[007] Among other things, a shifting mechanism in which a threaded spindle is driven by an electric motor is known from the US 4,498,350 publication. An axially displaceable element is provided on the threaded spindle, which is connected via spring elements to a frame, which is likewise axially displaceable by rotating the threaded spindle. An actuating element is, in turn, provided on the frame, which can selectively engage a first or a second gear wheel with the actuating element through the axial displacement of the frame.

[008] This familiar shifting mechanism has a very complicated configuration in terms of its constructional layout. Furthermore, a large number of elements is absolutely required for actuating the one or the other gear wheel.

[009] The present invention is based on the objective of proposing a gear shifting system in accordance with the kind described above, which has the lowest possible number of components and nevertheless enables simple and secure actuation of the gear shifting system.

[010] The objective is achieved in accordance with the invention through the features of patent claim 1. Further variations and advantages result from the dependent claims.

[011]

[012] Accordingly, a gear shifting system in accordance with the invention is proposed in which the shifting actuation or the adjustment of the respective sliding sleeves is provided by means of at least one adjusting unit, which actuates an actuator such that a desired shifting pattern is executed. One adjusting unit or several adjusting units, which are assigned to a sliding sleeve, form a so-called shifting set.

[013] This way, the gear shifting system of the invention enables a shifting actuation of the respective shifting sleeves without the involvement of shifting elements, such as drivers, shift rails and shift forks or the like. This reduces the number of required components significantly, since the gear shifting system in accordance with the invention allows shifting to be supported without additional actuating devices. For example, parallel shifting of the sliding sleeves or gear locking, which prevents the simultaneous engagement of two gears and a desired gear selection as well as desired shifting patterns can be enabled with little effort.

[014] Within the framework of further developing the present invention, it can be provided that electric motors or the like are used as the adjusting unit. It is also possible that adjusting units driven in a different fashion are used. As actuators, e.g., pins, slide blocks or the like, can be used, which are provided on the shaft of the adjusting unit preferably in an eccentric fashion. This way, the gear-maintaining function can occur from a circular motion of the shaft in the dead centers of the shifting path. Also gear switch-off can occur with the highest gear ratio of the circular motion from the dead centers. This way, the highest possible switch-off forces can be realized, which are an essential criterion for evaluating the gear shifting system.

[015] In the gear shifting system of the invention, it can preferably be provided that several adjusting units are installed for one sliding sleeve, which are arranged

preferably offset by about 180^0 about the main shaft. Other configurations are conceivable as well. For example, additional adjusting units can be used, which then are arranged evenly distributed across the circumference of the main shaft.

[016] It is especially beneficial if the respective rotational positions of the adjusting units or the servo-motors are detected. This way, parallel adjustments of the individual sliding sleeves are also possible. Furthermore, in this way gear recognition and gear securing operations can be performed. To detect the rotational positions of the shafts of the individual adjusting units, a central detection device, for example, or also several detection devices, which are provided in the individual adjusting units, respectively, can be used.

[017] In accordance with a beneficial further development, for example, a central control unit can be provided. The central control unit can realize vehicle-coordinated shifting in the gear shifting system in accordance with the invention. A computer or the like is preferably used as the central control unit. It is possible that the central control unit also includes the detecting unit.

[018]

[019] The invention is explained in further details in the following based on the appended figures, wherein:

[020] Fig. 1 depicts a sectional view of a gear shifting system in accordance with the invention;

[021] Fig. 2 depicts a cross-sectional view through a shifting set along the cutting line II-II in accordance with Fig. 1; and

[022] Fig. 3 depicts several enlarged basic representations of a respective actuator of an adjusting unit with the second gear engaged, in neutral position and with the first gear engaged.

[023]

[024] Fig. 1 shows a possible configuration of a gear shifting system in accordance with the invention, wherein only those components that are essential

for the invention are described. With respect to the reference numbers, the same reference number was used for several components of identical configuration.

[025] A main shaft 1 of the gear shifting system comprises several axially displaceable sliding sleeves 2, which are seated on the main shaft 1 in a torsion-resistant fashion. By means of axial displacement of the respective sliding sleeves 2, an idler wheels 3, that is supposed to be shifted, can be brought into a form lock with the sliding sleeves 2, wherein the idler wheels 3 are seated rotatably on the main shaft 1 and are engaged with at least one additional torque-transmitting element.

[026] In accordance with the invention, it is provided that the respective sliding sleeves 2 is actuated by at least one adjusting unit 4. Each adjusting unit 4 controls an actuator such that a shifting actuation of the respective sliding sleeves 2 is enabled.

[027] In the configuration of the gear shifting system proposed here, electric servo-motors are provided as adjusting units 4 for the purpose of adjusting the sliding sleeves 2, wherein corresponding cable connections 7 are provided for the power supply. A pin 5 is provided on the motor shaft 6 as the actuator in an eccentric fashion. The rotary motion of the motor shafts 6 is indicated in Fig. 1 by an arrow, respectively. The pin 5 is arranged in a recess 8 of the respective sliding sleeves 2, wherein the recess 8 is limited by two face sides 9 and 10. This is illustrated in Fig. 3. The pin 5 rests against the two face sides 9 and 10. As soon as the motor shaft 6 is rotated with the eccentric pin 5, the corresponding sliding sleeve 2 is displaced axially on the main shaft 1 so that the sliding sleeve 2 is then engaged form-locking with the respective idler wheels 3, which is supposed to be shifted.

[028] In a shifting set, the adjusting units 4 are respectively arranged offset across the circumference of the main shaft 1, preferably at an angle of 180^0, which is evident especially from Fig. 2.

[029] The individual servo-motors of a shifting set, as well as all servo-motors of several shifting sets, are suitably selected by a central control unit 11. In this

embodiment, four shifting sets are provided, wherein each shifting set comprises two adjusting units 4 on one sliding sleeve 2, respectively.

[030] The central control unit 11 preferably serves for vehicle-coordinated shifting and is suitably connected to the individual adjusting units 4 in terms of technical data transfer. To detect the respective rotational positions of the individual servo-motors e.g., each adjusting unit 4 can comprise a suitable detection device 12, indicated in Fig. 1 as a jagged arrow. This way a parallel adjustment of the sliding sleeves 2, gear recognition and also a gear-securing operation can be enabled.

[031] A sectional view of a shifting set is illustrated in Fig. 2. It is apparent from this Figure, as already indicated, that the adjusting units 4 are arranged offset from the main shaft 4 at an angle of 180°.

[032] Fig. 3 illustrates various rotational positions of a servo-motor with the pin 5 that is arranged eccentrically on the motor shaft 6. In the upper illustration, a gear, e.g., the second gear, is engaged, wherein in this state the sliding sleeve 2 cannot adjust the eccentrically arranged pin 5 because the adjusting lever arm is zero. Furthermore, the gear switch-off force is indicated by an arrow in this state.

[033] In the center illustration of Fig. 3, a neutral position is shown, i.e., in this state no gear is engaged. In the bottom illustration, again a shifted state is indicated, wherein the first gear is engaged.

Reference numerals

1	main shaft
2	sliding sleeves
3	idler wheel
4	adjusting unit
5	pin
6	motor shaft
7	cable connection
8	recess
9, 10	face sides
11	central unit
12	detection device